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A RISK ASSESSMENT AND GENERIC BIOLOGICAL EVALUATION OF THE SARATOGA SPITTLEBUG - CHEQUAMEGON NATIONAL FOREST, 1984

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INTRODUCTION

The Saratoga spittlebug, Aphrophora saratogensis (Fitch) continues to be a serious pest in young red pine, Pinus resinosa Ait., plantations in the Lakes States. Forest personnel on the Chequamegon National Forest, Washburn Ranger District, have become aware of increased spittlebug activity in some of their stands. In response to this, Forest Pest Management personnel made a service trip to the Washburn Ranger District in mid October 1984 for preliminary examinations and discussion of the spittlebug situation on their District. Field work during this visit revealed many plantations with an abundance of alternate hosts, particularly sweetfern, and significant Saratoga spittlebug populations.

A follow-up evaluation and risk appraisal was conducted by an FPM entomologist with the assistance of Ranger District personnel on December 10 and 11, 1984. This evaluation addressed only certain high risk stands identified by the District personnel. A biological evaluation of the Saratoga spittlebug on all other red pine plantations in the susceptible size range (approximately three to fifteen foot trees) is planned for the summer of 1985.

METHODS

We examined eight "suspect" plantations identified by Forest personnel from the Washburn Ranger District. The plantation were examined according to the methods described in "A Generic Evaluation of Saratoga Spittlebug in the Lakes States" (attached).

RESULTS

All eight of the stands examined were high risk. Table 1 summarizes the observations for each stand.

Table 1. -- Stand data summaries and risk ratings for the Washburn Ranger District, Chequamegon National Forest - 1984.

Comp.-Stand	Acres	Alternate Host	Average Tree Height (Feet)	Mean No. Scars	Stand Risk Rating	Treatment Priority
92-27	53	H	3.6	42	H	Treatment priority 1
109- 9	12	H	4.4	61	H	Treatment priority 1
109-13	10	H	4.0	32	H	Treatment priority 2
109-14	13	M-H	3.3	60	H	Treatment priority 4
109-24	61	H	4.0	52	H	Treatment priority 1
110- 8	25	M-H	6.9	30	H	Treatment priority 3
110-13	76	M-H	4.3	36	H	Treatment priority 2
110-14	82	M-H	5.5	41	H	Treatment priority 2

L = Low M = Moderate H = High

DISCUSSION

All the stands were at high risk due to the abundance of alternate hosts and the heavy Saratoga spittlebug feeding activity as evidenced by the high sample scar counts. This high risk takes on even greater importance when you consider the small size of the trees in many of these plantations. It will be 5 to 10 years before plantation closure occurs. Patchy areas with sparse stocking was observed in some instances - this situation also prolongs and/or prevents stand closure. Closure is important because spittlebug risk essentially drops to zero when closure shades out all the alternate hosts.

Plantation 109-14 had several areas of scattered sparse red pine stocking. Consequently this stand should be considered the lowest priority for treatment because it is questionable if closure ever would occur.

RECOMMENDATIONS

All eight plantations should be considered for an herbicide treatment with either glyphosate or hexazinone for control of the alternate host plants in 1985. The scar count samples indicate heavy feeding has been occurring for some time and the trees are under considerable stress. Successful herbicide treatment of the alternate host plants will result in low to zero risk plantations by 1986.

GENERIC BIOLOGICAL EVALUATION OF THE SARATOGA SPITTLEBUG IN THE LAKE STATES

Introduction:

The Saratoga spittlebug, Aphrophora saratogensis (Fitch), is a serious pest of young red pine plantations in the Lake States. Periodic scattered outbreaks of this insect have had an impact on all of the national forests in Michigan, Wisconsin, and Minnesota (Erickson and Millers 1969, Ford 1978, Haynes and Rush 1982, Millers 1969, 1970, Millers and Erickson 1969, 1970 and Rush 1980,). Although red pine is the preferred host, in the Lake States this spittlebug also attacks jack and white pines, white spruce, balsam fir, and tamarack. Young plantations with trees between four and twelve feet tall are the most susceptible, but larger trees are also damaged when stocking is sparse.

The insect overwinters in the egg stage under bud scales in the upper crown of host trees. In the spring, the emergent nymphs migrate to various nearby alternate host plants to form their spittle masses. They remain on these alternate hosts through all their nymphal stages. A variety of alternate hosts are utilized. Early nymphal stages can be found on several herbaceous plants such as orange hawkweed, wild aster, pearly everlasting, and many others. In fact, just about all herbaceous plants with the exception of grasses and sedges are alternate hosts. Later nymphal stages move to sweetfern, brambles, and willow and aspen sprouts. The adult spittlebugs move to the pine host in late June and early July.

Injury occurs when the adult spittlebug, with piercing and sucking mouthparts, penetrates the bark to feed. This feeding, which occurs mostly on the two year old internodes, causes the formation of necrotic resin-filled pockets in the phloem and xylem tissues. Heavy feeding leads to branch die-back characterized by reddish-brown "flagging", loss of form due to twisting and crooking, stunting, top-kill, and tree death. Tree death normally does not occur until after several years of heavy feeding.

The economic impact of such damage can be considerable, particularly when the damage results in the complete loss of a plantation. A recent survey on the Nicolet National Forest revealed that nearly 20 percent of the plantations in the susceptible age/size group were either complete failures or were severely threatened (Haynes and Rush, 1982). About 10-15 years ago the cost of establishing a plantation ran nearly $100 per acre. The present cost to reestablish that same plantation could be $300 per acre, or more. At that rate, losing one 40 acre plantation could result in $12,000 in reestablishment costs. That figure does not take into consideration the loss of the initial investment and the lost growth.

Objectives

The objectives of an evaluation are threefold: (1) to identify high risk plantations or plantations that are already experiencing spittlebug injury; (2) to assign risk ratings and/or treatment priorities to other susceptible red pine plantations; and (3) to make management recommendations for plantations examined.

Methods

Forest personnel provide Forest Pest Management with a list of "probable" stands using a computer generated listing of young red pine plantations. Since the spittlebug is a pest of young plantations, age can be used as a parameter to approximate tree size for computer sorting purposes. All red pine plantations between 5 and 15 years old should be considered.

Using compartment maps for the particular Forest, a surveyor plots lines to obtain representative coverage of each plantation. Samples are collected and observations made along these survey lines at intervals of 2-6 chains, (40-120 m) keeping at least 1 chain (20 m) from the plantation edge. The number of samples collected is determined by the plantation acreage (Table 1) with a minimum of 10 samples and observations made per plantation. A sample consists of one 4" twig for feeding scar numbers. Observations include notations on the species and relative abundance of alternate hosts, the amount of crooking and flagging, stand vigor, stand closure, and host tree height.

Table 1.--Intensity of scar count sampling in red pine plantations.

Plantation Size in acres	Minimum Number of samples
0-10	10
11-20	15
21-80	20
81-160	30
161-240	40
241-320	50
321 and up	60 (+1 for each additional 8 acres)

Populations are estimated by using a spittlebug feeding scar count technique. A 4 inch (10cm) sample is cut from the penultimate internode of a branch in the upper third of the crown. The bark is carefully peeled from this segment and the tan-colored feeding scars are counted and recorded (Form 1, Appendix). If this sampling is conducted in the early spring before shoot elongation has occurred, it will provide an index of last year's spittlebug populations. If performed in the late summer or fall, it provides an index of the current year's spittlebug populations.

Observations are also made on the composition and relative abundance of the alternate host plants. Findings are recorded on the survey form. Particular attention is paid to such plants as sweetfern, brambles, and willow, but herbaceous alternate hosts are also evaluated. Risk categories of light, moderate, or heavy are assigned using Wilson's technique (1978).

Other factors to consider and record are the presence and relative amount of tree crooking and branch flagging, if any; stocking level and the proximity to stand closure; and observations on the overall vigor and condition of the stand.

All of this information is then compiled and analyzed so that a risk rating can be assigned to each stand examined. Assignment of risk ratings for a stand is somewhat subjective, but generally follows the categories as outlined in Table 2. Actual risk ratings are determined from overall impressions of stand condition and not always from strict adherence to the risk factor categories. For instance, greater weight is placed on the feeding scar counts and the presence of crooking and flagging as these factors indicate actual rather than potential spittlebug populations.

Table 2--Rating factors considered in evaluating and assigning Saratoga spittlebug risk to red pine plantations.

No. of Scars	Crooking & Flagging	Alternate Hosts	Stand Closure	Stand Vigor	Risk Assignment
1-5	None	Few	Closed	Good	Low
6-10	Some	Moderate	Nearly	Fair	Moderate
11+	Heavy	Abundant	Open	Poor	High

The field data and risk assignments are summarized in tabular format and management recommendations are made for all the stands examined.

Discussion

The Saratoga spittlebug is an insidious forest pest. Initially, the damage is not dramatic like it is with other forest insects such as the spruce budworm, the forest tent caterpillar, or the gypsy moth. Because the damage is more subtle and may periodically affect only a few scattered plantations, it is an easy insect to forget. By the time the injury is readily apparent, it is often too late to save the plantation. That being the case, successful spittlebug management relies on an integrated approach that addresses site selection, alternate host management with herbicides, aggressive surveillance, and some routine periodic stand examinations.

Prevention is a more biologically sound and economically acceptable alternative than suppression in spittlebug management. The key factor in prevention is the avoidance, or management, of alternate host plants. If red pine is planted on sites where there is little or no alternate host material, there will be no problem with spittlebug buildups. This is an important

factor to consider when plantation establishment is being planned. Ideally, an alternate host risk rating survey (Wilson 1978) should be conducted before red pine is planted. Should the survey reveal high risk, planting red pine should be avoided if possible. If red pine is planted regardless of abundant alternate hosts, the resource manager should recognize that preventative or suppressive measures will likely become necessary at some point in the early development of the stand.

Prevention of spittlebug damage in established plantations that support an abundance of alternate hosts is best accomplished with herbicides. Chemical removal of alternate hosts eliminates the threat of damage by spittlebug and provides the benefits of release at the same time.

Most of the national forests in the Lake States already have many red pine plantations on sites that are considered high risk. Until these stands are treated to reduce the abundance of alternates hosts, or until the stands grow out of the susceptible size range and closure occurs, it is essential that they be inspected regularly. High risk stands should be checked at least every two years but once annually is preferable. Regular inspection provides early detection of incipient spittlebug outbreaks thus allowing managers the time necessary to evaluate the situation and consider management alternatives before damage occurs. This early detection can be achieved through two kinds of inspections--periodic scheduled stand examinations and aggressive routine surveillance.

Periodic scheduled examinations differ from surveillance in that they do not rely on "chance" coverage through routine activities, but are actually scheduled. The observations made need be no more intense or detailed than those made on a surveillance check. Even under aggressive surveillance, a plantation could go unvisited for several years. However, scheduled examinations can prevent such oversight from occurring; this is important for high risk plantations.

Surveillance, means to keep a close watch over something. It is not a structured survey of some type, but is simply a monitoring that is accomplished as an ongoing part of normal activities. When driving by a plantation, stop and take a look. It is basically just being aware and keeping your eyes open for somethings amiss. This surveillance is extremely important because young plantations are routinely visited only at one, three, and five years after planting for survival and stocking surveys and at ten year intervals thereafter for compartment examinations.

The one, three, and five year inspections lend themselves reasonably well to spittlebug management. At the one year inspection, notes can be made on the relative abundance of alternate host plants. Similar observations can be made at the three year visit. The trees should be just coming into the susceptible size range for spittlebug at the time of the five year stocking survey. However, the real inspection problem arises during that period after the three or five year visit. If the plantation is well stocked and appears thrifty at the three year stocking survey, the five year survey may not be made. If by chance the normal ten year compartment examination falls within a year or so before the last stocking survey, the plantation could go uninspected for about nine years. This nine year period is during the time

frame when a plantation is most vulnerable to Saratoga spittlebug. The trees have grown into the susceptible size range and alternate host plants have become reestablished since the initial site preparation. With such optimum conditions, severe damage can occur in two to three years of unchecked, heavy spittlebug feeding. That is why routine scheduled examinations of the high risk plantations are so important.

Another important consideration in spittlebug management is to recognize that stand conditions are not static and can change fairly rapidly. The growing trees are either coming into, or possibly passing out of, the susceptible size range. Changes in stocking due to tree mortality can affect alternate host abundance. Spittlebug population levels are subject to considerable fluctuation over a relatively short period of time within a stand and among stands. For these reasons surveillance is essential until stand closure occurs. Scheduled examinations should be concentrated on the highest risk stands so that prevention, release, or possibly control can be performed before permanent damage occurs. If you do not continually monitor the changing stand situations, you cannot be sure that you are dealing with those stands of highest hazard.

Better sites with vigorous growing trees are often less vulnerable to other types of pest attack, but such seems not to be the case with Saratoga spittlebug. Plantations have been observed where past growth has averaged nearly two feet per year until several seasons of spittlebug attack have severly suppressed growth and caused dieback or heavy tree mortality.

Management Alternatives

Management recommendations vary with stand condition, spittlebug population levels, alternate host abundance, and timing constraints. Management alternatives include:

1. RISK RATE--

   It is difficult to decide upon a course of action until you are aware of the factors influencing the situation. That is why a risk rating survey is so important. If plantation establishment is being considered, an estimate of the alternate host abundance for a given site could be very helpful in determining whether red pine would be a good choice for that particular site. If you are dealing with a plantation that is already established, an estimate of alternate host abundance is very useful in evaluating risk and selecting a management alternative.

2. NO ACTION--

   Sometimes benefit/cost considerations dictate a "do nothing" approach to spittlebug management. Also, there are instances where low risk stands seem quite secure for the time being; or, perhaps other management considerations suggest doing nothing and taking a chance on the outcome. This alternative is legitimate, and often the best one, but continued surveillance is still suggested.

3. MONITOR--

There may be instances where immediate treatment of some sort is not necessary, but conditions appear questionable or suspect. An inspection schedule will help you to detect changes, either favorable of unfavorable, in pest levels or stand conditions. Early detection of problems afforded by an accelerated inspection schedule provides the resource manager the time necessary to formulate and initiate corrective actions.

4. STOCKING SURVEY--

In cases where stocking appears sparse or patchy due to tree mortality, a stocking survey may be useful to assess fill-in planting or replanting needs. Full stocking is important not only from the production standpoint, but also from obtaining more rapid crown closure thereby removing the spittlebug threat because their alternate hosts are shaded out. If the cause of tree mortality was the spittlebug, the use of herbicides to remove the alternate hosts should be considered as a followup to the fill-in or replanting.

5. HERBICIDE TREATMENT--

Where alternate hosts are abundant the use of an herbicide should be considered to reduce the hazard to the red pine plantation. Springtime applications of liquid or granular hexazinone (Velpar®)[1/] or late summer and fall applications (before leaf fall) of liquid glyphosate (Roundup®) will effectively reduce alternate host abundance and the risk of spittlebug buildups. At the same time, the plantation will receive the benefits of release from competition with herbaceous plants, grasses, and other shrub growth.

6. INSECTICIDE TREATMENT--

If a spittlebug problem goes undetected until serious injury has occurred and the trees are under considerable stress, the application of an insecticide might be necessary to prevent further injury and loss of the plantation. If damage is advanced, and thus it is difficult to assess how much recovery may occur for a given situation, the plantation may fail in spite of the treatment. Even if the plantation is protected, the results are temporary and additional treatments may be necessary. If the insecticide treatment is accompanied by an herbicide treatment to remove alternate hosts, the protection is considerably more long lasting.

1/ The use of trade, firm or corporation names is for the information and convenience of the reader. Such use does not constitute an official evaluation, conclusion recommendation, endorsement, or approval of any product or service to the exclusion of others which may be suitable.

7. ABANDONMENT--

Occasionally spittlebug infestations remain undetected for so long that the plantation is damaged beyond recovery. When such is the case, the best alternative is to clear, perform site preparation and replant. When possible, the site should be converted to some species other than red pine. If a proven high risk site must be planted back to red pine, then it should be understood that the use of herbicides to control the alternate hosts is essential.

A Decision Making Process

Establishing and managing young red pine plantations in a moderate to high hazard Saratoga spittlebug areas can be very risky. There are many site, biological, and economic variables to consider in deciding on a management strategy. The two flow charts depicted in Figures 1 and 2 suggest a decision making process that may be helpful to District personnel in making management decisions pertaining to young red pine plantings.

Figure 1.--A flow chart for a decision making process pertaining to proposed planting sites.

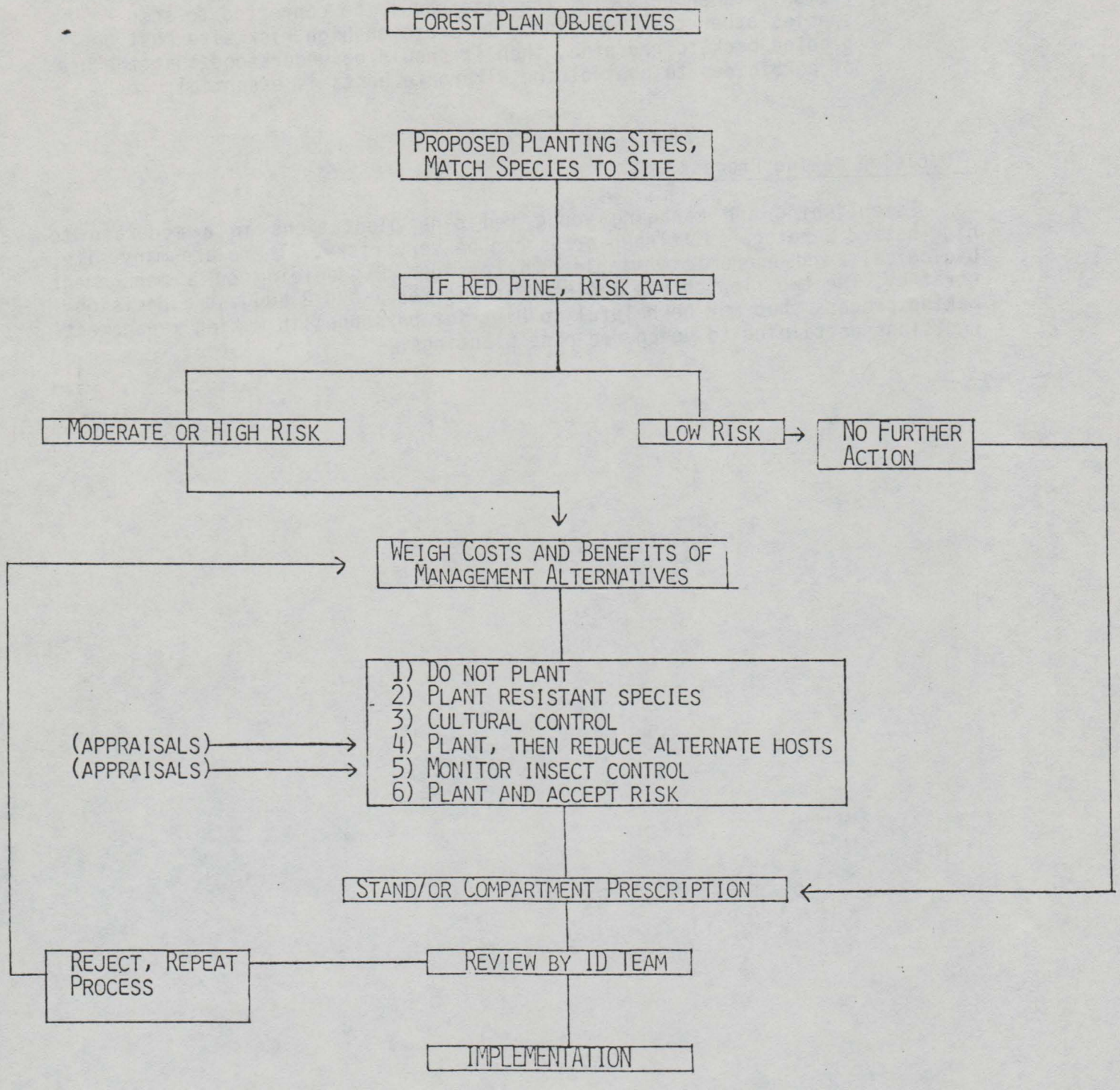
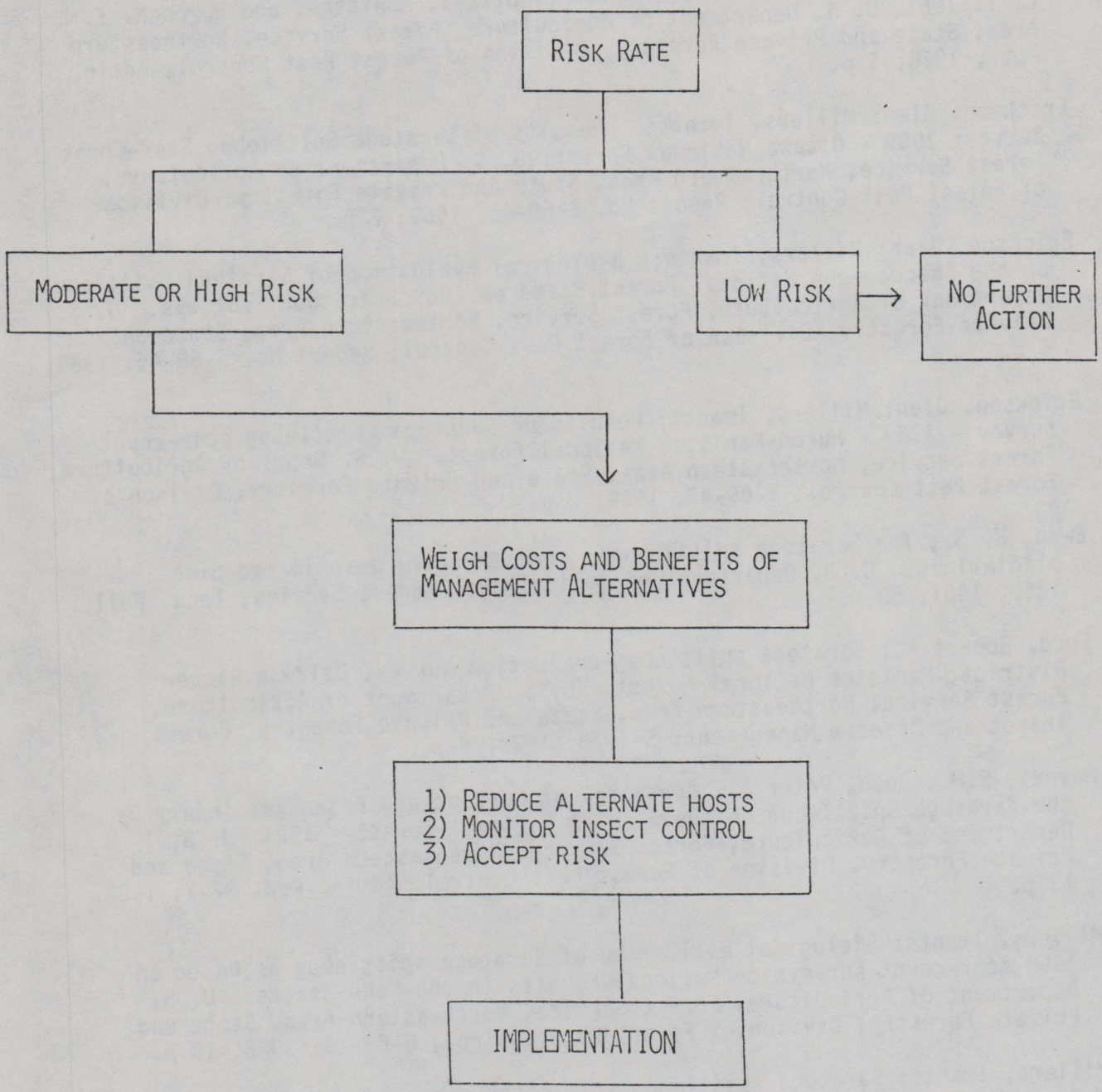


Figure 2.--A flow chart for a decision making process pertaining to established young red pine plantations.



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APPENDIX FORM 1.

SARATOGA SPITTLEBUG
SCAR COUNT SURVEY

Date

Observer(s)

Forest:

District:

Compartment: Stand:

FIELD DATA SUMMARY

Relative Amount Sweetfern:

Relative Amount Brambles:

Relative Amount Other Alt. Hosts:

Mean No. scars/sample:

Mean tree height:

Relative Amount of Flagging:

Comments:

Sample tree				Sample tree			
No.	Scars/10 cm.	Alt. Host	Height	No.	Scars/10 cm.	Alt. Host	Heigh
1				26			
2				27			
3				28			
4				29			
5				30			
6				31			
7				32			
8				33			
9				34			
10				35			
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